FIGURE 1

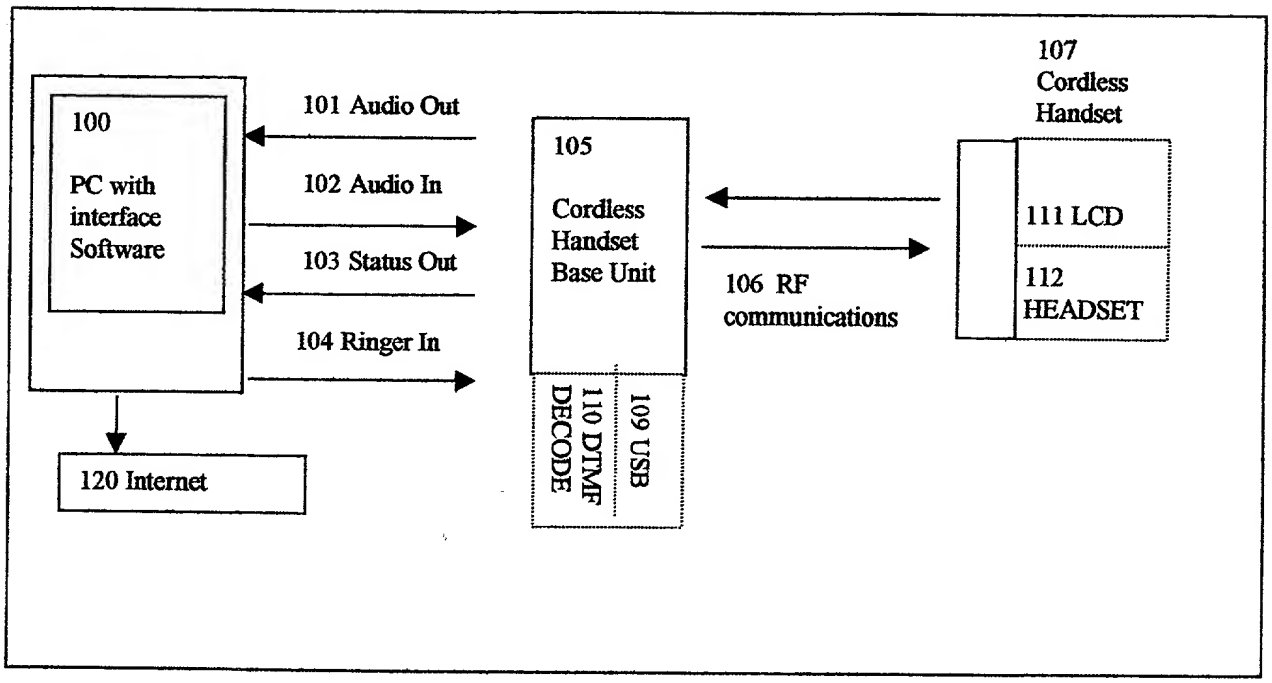

100
PC with interface Software
101 Audio Out
102 Audio In
103 Status Out
104 Ringer In
120 Internet
105
Cordless Handset Base Unit
110 DTMF DECODE
109 USB
106 RF communications
107 Cordless Handset
111 LCD
112 HEADSET

FIGURE 2

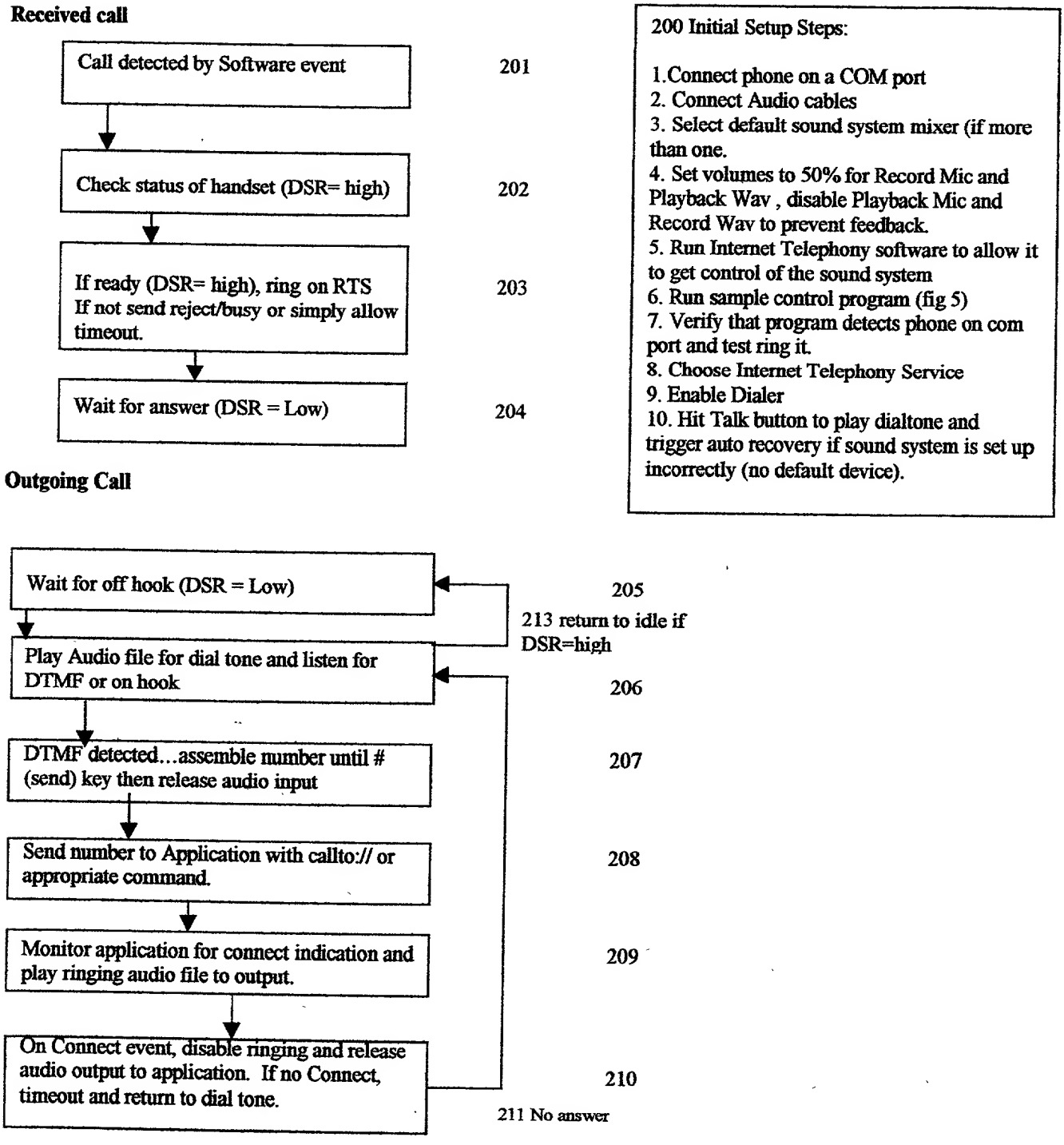
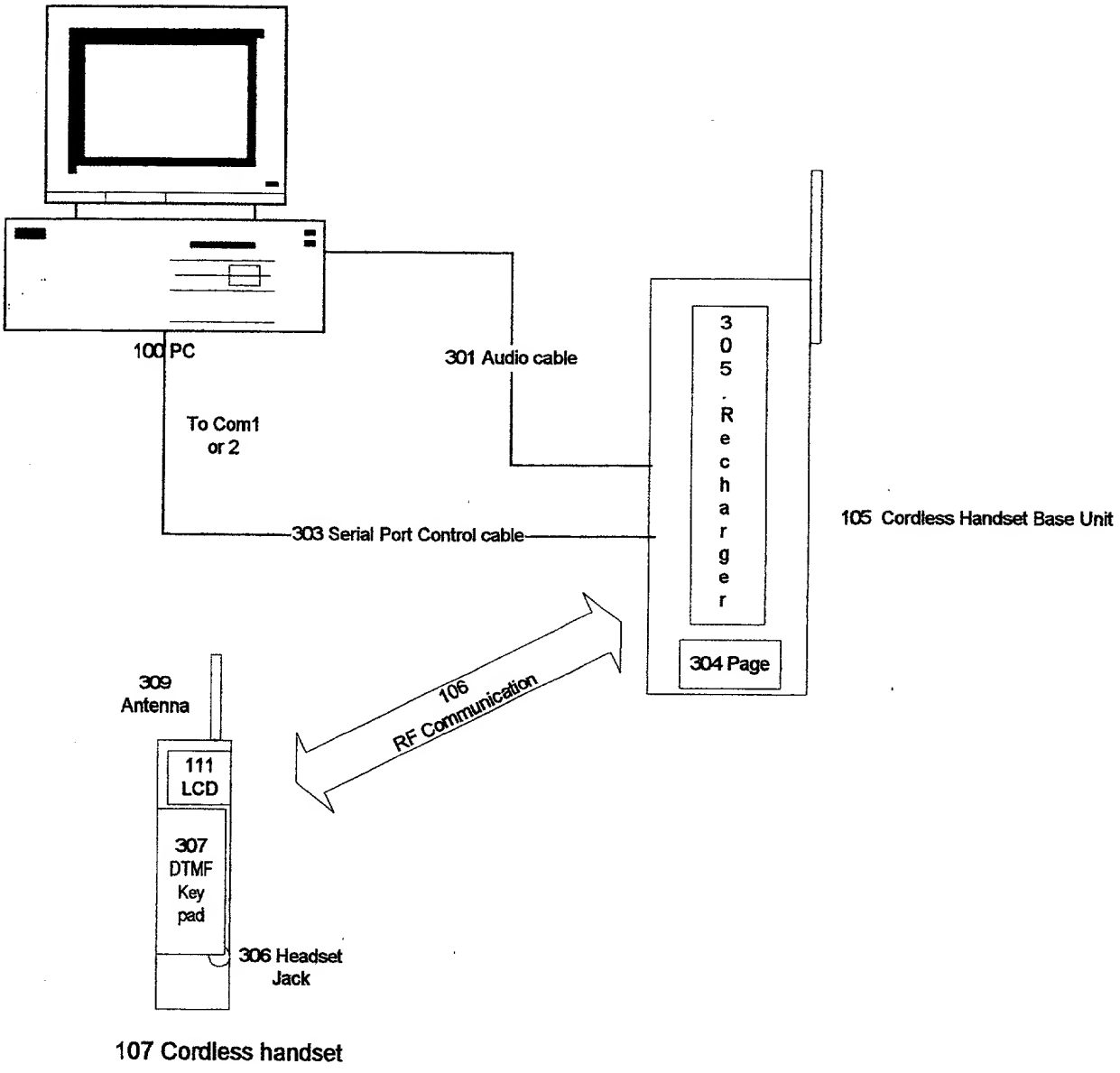

Received call
Call detected by Software event
201
Check status of handset (DSR= high)
202
If ready (DSR= high), ring on RTS
If not send reject/busy or simply allow timeout.
203
Wait for answer (DSR = Low)
204
200 Initial Setup Steps:
1.Connect phone on a COM port
2. Connect Audio cables
3. Select default sound system mixer (if more than one.
4. Set volumes to 50% for Record Mic and Playback Wav , disable Playback Mic and Record Wav to prevent feedback.
5. Run Internet Telephony software to allow it to get control of the sound system
6. Run sample control program (fig 5)
7. Verify that program detects phone on com port and test ring it.
8. Choose Internet Telephony Service
9. Enable Dialer
10. Hit Talk button to play dialtone and trigger auto recovery if sound system is set up incorrectly (no default device).
Outgoing Call
Wait for off hook (DSR = Low)
205
213 return to idle if DSR=high
Play Audio file for dial tone and listen for DTMF or on hook
206
DTMF detected...assemble number until # (send) key then release audio input
207
Send number to Application with callto:// or appropriate command.
208
Monitor application for connect indication and play ringing audio file to output.
209
On Connect event, disable ringing and release audio output to application. If no Connect, timeout and return to dial tone.
210
211 No answer

Figure 3


100 PC
To Com1
or 2
301 Audio cable
303 Serial Port Control cable
305. Recharger
304 Page
105 Cordless Handset Base Unit
106
RF Communication
309
Antenna
111
LCD
307
DTMF
Key
pad
306 Headset
Jack
107 Cordless handset

# Figure 4 Simplified Block Diagram

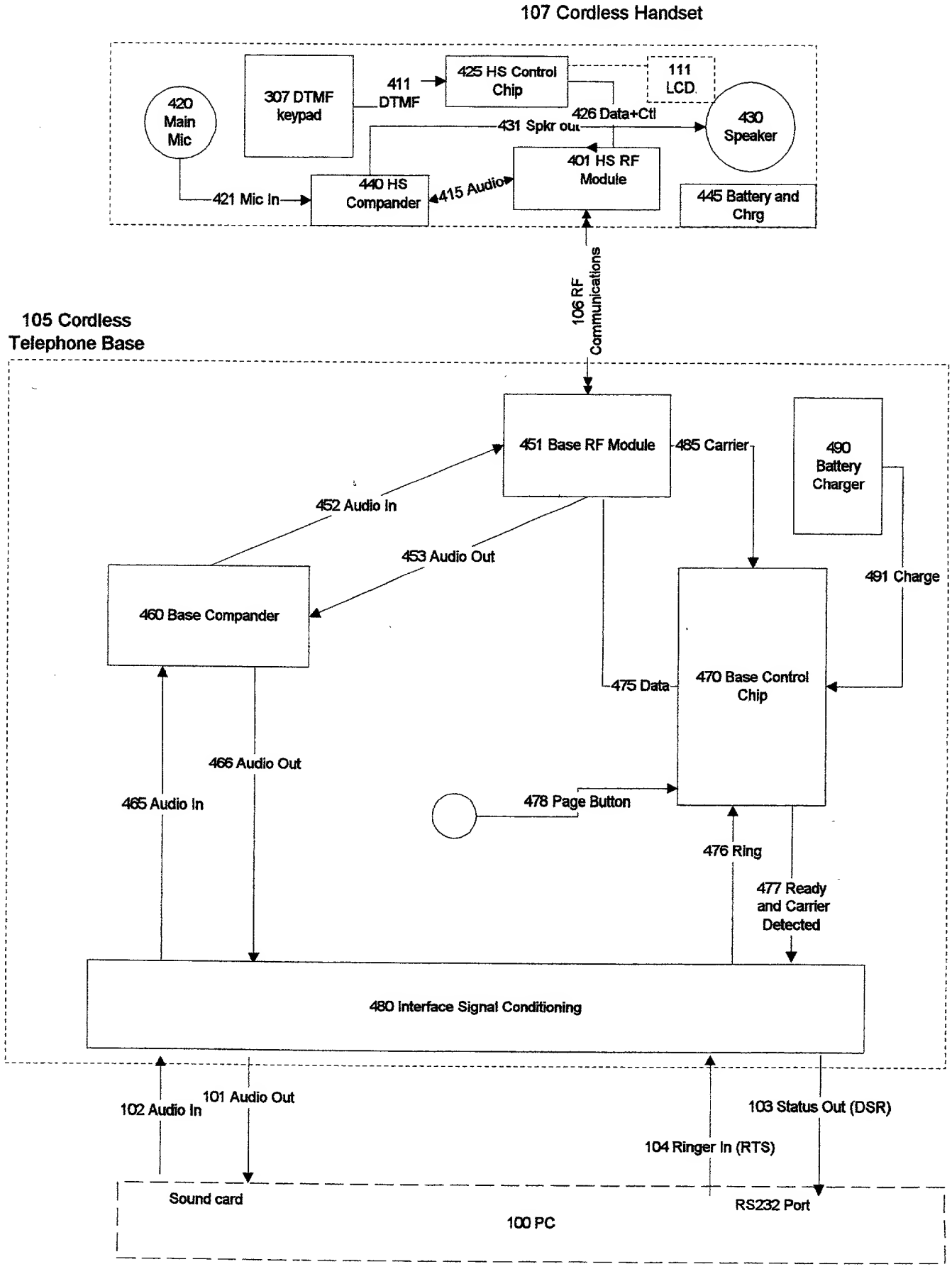


Figure 5 Graphical user interface

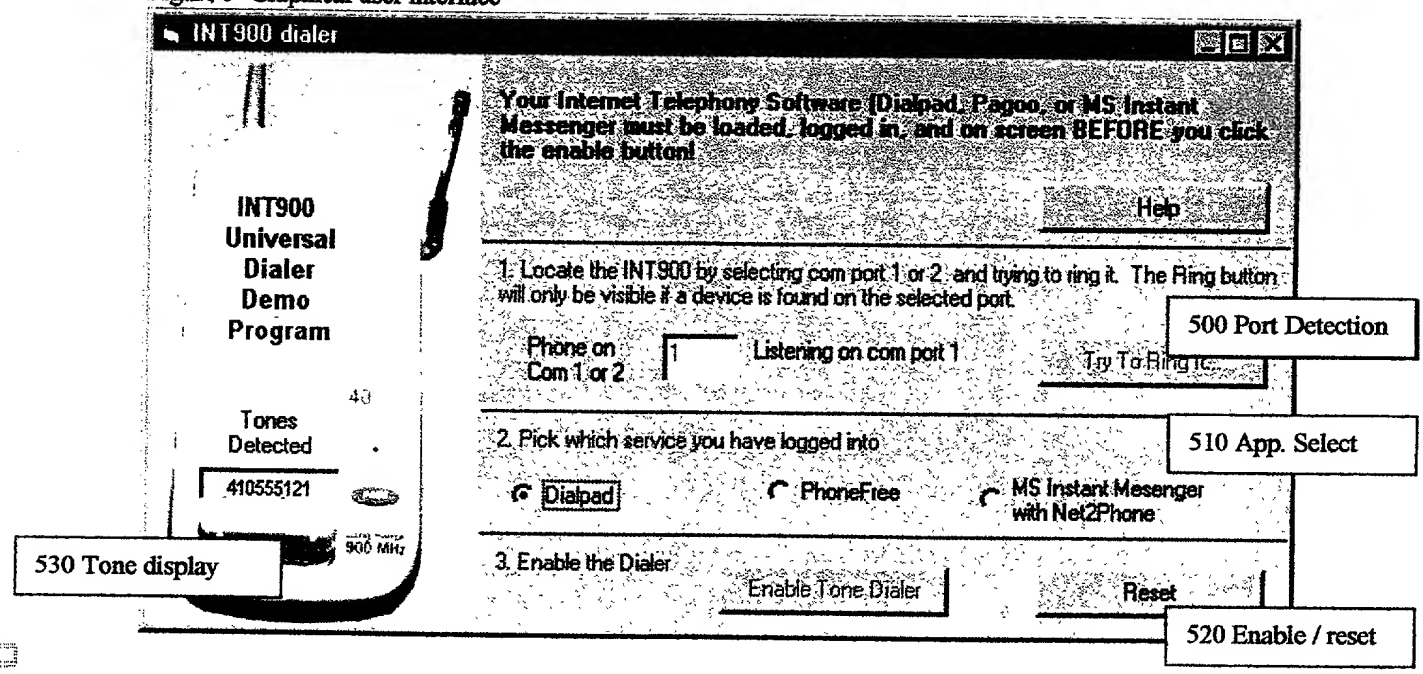


Figure 6 Visual Basic Program Listing

```
' ------------------------------------------------------------
'Sample listing for setup of DTMF recognition and serial port operations related to use of the Cordless
Internet Telephone  to emulate a POTS call using one of several service providers.


Misc. (Types, Enums, Constants...)
' ------------------------------------------------------------

' Means to use a default or automatic value
Global Const ttAutomatic = -1

' Errors used by ttLib
Enum ttErrors
   tteNoError = 0
   tteUnknown
   tteNotSupported
   tteOutOfMemory
   tteWaveDeviceDidNotOpen
   tteWrongState
   tteBadParameter
End Enum

' Most ttLib functions return a success value
Enum ttSuccessValue
   ttscFailure = 0
   ttscSuccess = -1
End Enum

' Used by ttInitializeExInfo and ttInitialize()
Enum ttCallbackMethods
   ttcmPostMessage = 0       ' PostMessage to a given window
   ttcmSendMessage = 1       ' SendMessage to a given window


   ttcmDirectFunction = 2    ' Call a function DIRECTLY FROM THE RECOGNIZER THREAD
End Enum

' Used by ttInitializeEx()
Type ttInitializeExInfo
   StructSize As Long              ' LenB(ttInitializeExInfo)

   CallbackMethod As ttCallbackMethods    ' Desired form of callback
   CallbackInfo1 As Long              ' If CB method is DirectFunction, this is a
                           ' Function pointer of a CallbackType function.
                           ' If CB method is Send/PostMessage, this is
                           ' the target hWnd.
   CallbackInfo2 As Long              ' If CB method is Send/PostMessage, this is the
                           ' window message to send or ttAutomatic.

   MinNoise As Long                ' Noise gate level or ttAutomatic
   ToneDuration As Long               ' Number of 12.75ms sampling windows needed
                           ' for tone or ttAutomatic
   SilenceDuration As Long            ' Number of 12.75ms sampling windows needed
                           ' for silence or ttAutomatic
   SignalToNoise As Long              ' Signal to noise ratio or ttAutomatic
   RowRatio As Long                ' Primary to harmonic ratio for rows or
```

```
                                ' ttAutomatic
    ColRatio As Long                    ' Primary to harmonic ratio for columns or
                                ' ttAutomatic
    DeviceOverride As Long              ' Audio input device to use or ttAutomatic
End Type

' ---------------------------------------------------------------------------



' ---------------------------------------------------------------------------
' Interface functions
' ---------------------------------------------------------------------------

' You call Initialize() or InitializeEx() when you first load the DLL or
' when you want to change some of the parameters.  They are NOT meant to
' be called while recognition is in progress.  The results of calling them
' while recognition is in progress are undefined.
' The ttInitializeExInfo struct passed to InitializeEx() will be returned
' with all ttAUTOMATIC values replaced by their defaults.  The struct can
' freed immediately.
Declare Function ttInitialize Lib "ttLib" (ByVal Method As ttCallbackMethods, ByVal CallbackInfo1 As
Long) As ttSuccessValue
Declare Function ttInitializeEx Lib "ttLib" (ttLibInitializeExInfo As ttInitializeExInfo) As ttSuccessValue

' Starts up recognition
Declare Function ttBeginRecognition Lib "ttLib" () As ttSuccessValue

' Stops recognition.  Failing to call this is an easy way to crash your app.
Declare Function ttEndRecognition Lib "ttLib" () As ttSuccessValue

' Returns an error value.
Declare Function ttGetErrorVal Lib "ttLib" () As ttErrors
' ---------------------------------------------------------------------------


' This is the prototype to use for callbacks functions.  With VB6, this is
' useless unless you really know what you're doing.  With VB5, it should
' be a breeze.
' Sub CallbackProc(ByVal Char As Byte)



'The following Communications constants are from win32api.txt:
-------------------------------------------------------------------------------

'EscapeCommFunction values
Global Const SETXOFF = 1
Global Const SETXON = 2
Global Const SETRTS = 3
Global Const CLRRTS = 4
Global Const SETDTR = 5
Global Const CLRDTR = 6
Global Const RESETDEV = 7
Global Const GETMAXLPT = 8
Global Const GETMAXCOM = 9
Global Const GETBASEIRQ = 10
```

```
'Global variables & constants

Public CommPorts() As String
Public PortExists As Boolean
Public Com1PortInUse As Boolean
Public Com2PortInUse As Boolean
Public PortNumber As Integer
Public PortOpen As Boolean
Public NumberOfPorts As Integer

Public ValidPort As Boolean
Public dtmf As String
Public getting_tone As Boolean

'API declares:

Declare Function PlaySound _
   Lib "winmm.dll" _
   Alias "PlaySoundA" _
   (ByVal lpszName As String, ByVal hModule As Long, ByVal dwFlags As Long) As Long


Public Declare Function EscapeCommFunction _
   Lib "kernel32" _
   (ByVal nCid As Long, _
   ByVal nFunc As Long) _
   As Long


Public Declare Function timeGetTime _
   Lib "winmm.dll" () _
   As Long
```

---

```
Public Sub Delay(DelayInMilliseconds As Single)
'Delay timer with approximately 1-msec. resolution.
'Uses the API function timeGetTime.
'Rolls over 24 days after the last Windows startup.
Dim Timeout As Single
Timeout = DelayInMilliseconds + timeGetTime()
Do Until timeGetTime() >= Timeout
   DoEvents
Loop
End Sub
```

---

```
Public Sub ShutDown()
'Close the port.
If Form1.MSComm1.PortOpen = True Then
   Form1.MSComm1.PortOpen = False
```

```
End If
End Sub


Private Const WM_LBUTTONUP = &H202
Public dialing As Boolean
Public dialtoneplaying As Boolean
Public talking As Boolean

---

Private Sub CallbackTarget_MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
   ' When the recognizer gets a valid tone, it sends a window message with
   ' both the LPARAM and the WPARAM as the ASCII value of the key.  Since we
   ' specified WM_LBUTTONUP as the message and CallbackTarget.hWnd as the window
   ' in our call to ttInitializeEx() -- this MouseUp event ends up firing when
   ' a key is recognized!
   ' For a normal WM_LBUTTONUP message, the X position of the mouse is in the
   ' low word of the LPARAM.  Since VB uses that for the X parameter... the
   ' key's ASCII value is now in X!  Note that CallbackTarget's ScaleMode is
   ' vbPixels.  If it was something else, VB would have multipled the real
   ' low word of LPARAM by something to make X (i.e., if ScaleMode = vbTwips,
   ' we'd want to do txtKeys.SelText = Chr$(X \ Screen.TwipsPerPixelx)).  Don't
   ' sweat it.  Just make sure your callback.target's ScaleMode is vbPixels!

   Status.SelStart = Len(Status.Text)
   Status.SelText = Chr$(X)
End Sub

---


Private Sub EnableDialer_Click()

   If PickMSIM.Value = False And PickDialpad.Value = False And PickPhoneFree.Value = False Then
      MsgBox "You must select a program first"
      Exit Sub
   End If



   PortNumber = Text1.Text
   If Form1.MSComm1.PortOpen = True Then Form1.MSComm1.PortOpen = False
   Form1.MSComm1.CommPort = PortNumber
   If Form1.MSComm1.PortOpen = False Then Form1.MSComm1.PortOpen = True


    ---


     'start capturing tones

     If ttBeginRecognition = ttscFailure Then
           MsgBox "Failed to start DTMF recognition! Is your sound system in use by another program?" &
vbNewLine & "Error " & CStr(ttGetErrorVal), vbExclamation
           Exit Sub
        End If
    Status.Text = ""
   dialing = True
   If PickDialpad.Value = True Then Timer1.Enabled = True
```

```
    If PickMSIM.Value = True Then Timer2.Enabled = True
    If PickPhoneFree.Value = True Then Timer3.Enabled = True
    EnableDialer.Enabled = False
    Command2.Enabled = False
    Text1.Enabled = False
    Text2.Text = "Listening on com port " & PortNumber

End Sub

---

Private Sub Command2_Click()
PortNumber = Text1.Text
Call ringit
Call ringit ' sometimes the detection circuit needs a second ring
End Sub

---

Private Sub ringit()
'rings the handset until answered
If MSComm1.PortOpen = True Then MSComm1.PortOpen = False
'Change Comm port here
MSComm1.CommPort = PortNumber
If MSComm1.PortOpen = False Then MSComm1.PortOpen = True
Dim Commhandle As Long
Commhandle = Form1.MSComm1.CommID

Do
   Dim Timeout As Single
   Timeout = timeGetTime() + 500
   Do
      RTSOn = SETRTS
      Success = EscapeCommFunction(Commhandle, RTSOn)
      Delay (25)
      RTSOn = CLRRTS
      Success = EscapeCommFunction(Commhandle, RTSOn)
      Delay (25)
   Loop While (timeGetTime() <= Timeout)
Delay (1000)
'Wait for off hook
Loop While MSComm1.DSRHolding = True
If MSComm1.PortOpen = True Then MSComm1.PortOpen = False

End Sub

---

Private Sub Reset_Click()
'reset everything and stop timers
   ttEndRecognition
   If Form1.MSComm1.PortOpen = True Then Form1.MSComm1.PortOpen = False
   Call dialtone_off
   Timer1.Enabled = False
   Timer2.Enabled = False
   Timer3.Enabled = False
```

```
    EnableDialer.Enabled = True
    Command2.Enabled = True
    Delay (1000) 'give the phone a second to settle in case they just hung up
    Call Text1_Change
End Sub

---

Private Sub Command4_Click()
    Dim htmlpath
    htmlpath = App.Path & "\index.html"
    frmBrowser.StartingAddress = htmlpath
    frmBrowser.Show
End Sub

---

Private Sub Form_Load()
'set up state variables
    dialing = False
    dialtoneplaying = False
    talking = False
    Text1.Text = 1
    PortNumber = Text1.Text
    Call Text1_Change
 ---

 'set up dtmf detector
 Dim IEI As ttInitializeExInfo
    With IEI
        .StructSize = LenB(IEI)

        .CallbackMethod = ttcmPostMessage

        ' CallbackInfo1 is the target window for window-based callbacks
        .CallbackInfo1 = CallbackTarget.hWnd

        ' CallbackInfo2 is the WM to send for window-based callbacks
        .CallbackInfo2 = WM_LBUTTONUP

        ' Use the defaults...
        .ColRatio = ttAutomatic
        .DeviceOverride = ttAutomatic
        .MinNoise = ttAutomatic
        .RowRatio = ttAutomatic
        .SignalToNoise = ttAutomatic
        .SilenceDuration = ttAutomatic
        .ToneDuration = ttAutomatic
    End With

    If ttInitializeEx(IEI) = ttscFailure Then
        MsgBox "Failed to initialize ttLib!" & vbNewLine & "Error " & CStr(ttGetErrorVal), vbExclamation
        Unload Me
        Exit Sub
    End If

    ' ttInitializeEx will have filled in all the ttAutomatic values, so
```

```
    ' we can see what they are now if you uncomment the box below...
    'MsgBox "Tone duration is " & Format$(IEI.ToneDuration * 12.75, "#.##") & vbNewLine & _
      "Silence duration is " & Format$(IEI.SilenceDuration * 12.75, "#.##"), _
      vbInformation, "Info"

End Sub

---------------------------------------------------------------------------
Private Sub PickDialpad_Click()
    PickMSIM.Value = False
    PickPhoneFree.Value = False
End Sub
---------------------------------------------------------------------------
Private Sub PickMSIM_Click()
    PickDialpad.Value = False
    PickPhoneFree.Value = False
End Sub
---------------------------------------------------------------------------
Private Sub PickPhoneFree_Click()
    PickMSIM.Value = False
    PickDialpad.Value = False
End Sub
---------------------------------------------------------------------------

Private Sub Text1_Change()
' check for DSR on selected port to sense a device
'note that IR ports also give a positive response, it might not be the phone

    On Error Resume Next
    If Text1.Text = "" Then Exit Sub
    If Text1.Text > 0 And Text1.Text < 3 Then PortNumber = Text1.Text
    If Form1.MSComm1.PortOpen = True Then Form1.MSComm1.PortOpen = False
    Form1.MSComm1.CommPort = PortNumber
    If Form1.MSComm1.PortOpen = False Then Form1.MSComm1.PortOpen = True
    If Form1.MSComm1.DSRHolding = True Then
       Text2.Text = "Device found on port"
       Command2.Visible = True ' display a test ring button
    Else
       Text2.Text = "Device not ready or not found on com port"
       Command2.Visible = False
    End If
    If Text1.Text > 2 Then Text1.Text = 1
End Sub



---------------------------------------------------------------------------

Private Sub Timer1_Timer()
If dialing = True And Form1.MSComm1.DSRHolding = False Then

   'check to see if I should start dialtone
    If dialtoneplaying = False And Status.Text = "" Then Call dialtone_on

   'wait for right number of digits, and kill dialtone on the first one
    If Len(Status.Text) > 0 Then
     Call dialtone_off
       If Len(Status.Text) > 9 Then
          ' recognition is ended
```

```
        ttEndRecognition
        'run the application
        AppActivate ("Dialpad.com [")
        'send it the right keystrokes to dial
        SendKeys "{TAB 13}" & "~" & "{BKSP}" & Status.Text & "~", 0
        dialing = False
        talking = True
      End If

   End If ' if flag = true

End If

'reset everything on a hangup
If talking = True And Form1.MSComm1.DSRHolding = True Then
   talking = False
   AppActivate ("Dialpad.com [")
   SendKeys "%{F4}", 1 'alt F4 closes window
   DoEvents
   Delay (300)
   AppActivate ("Dialpad")
   SendKeys "%vr", 1
   Delay 10000
   dialing = True
   Call EnableDialer_Click
End If
If dialing = True And MSComm1.DSRHolding = True And Status.Text > "" Then
      Call dialtone_off
      Status.Text = ""
End If
End Sub
-----------------------------------------------------------------------

Private Sub Timer2_Timer()
'This timer routine is for Microsoft Instant Messenger/Net2Phone
' don't waste time if phone is on hook
If dialing = True And Form1.MSComm1.DSRHolding = False Then

'check to see if I should start dialtone
   If dialtoneplaying = False And Status.Text = "" Then Call dialtone_on

   'wait for right number of digits, and kill dialtone on the first one
   If Len(Status.Text) > 0 Then
    Call dialtone_off
      If Len(Status.Text) > 10 Then
         ' recognition is ended
         ttEndRecognition
         'run the application
         AppActivate ("MSN Mess")
         SendKeys "%TCD", 1
         AppActivate ("Phone Call")
         SendKeys Status.Text & "~"
         dialing = False
         talking = True
         Status.Text = ""
      End If

   End If ' if flag = true
End If
```

```
If talking = True And Form1.MSComm1.DSRHolding = True Then
   talking = False
   AppActivate ("Phone Call")
   SendKeys "%U", 1
   Delay (500)
   EnableDialer_Click
End If
   If dialing = True And MSComm1.DSRHolding = True And Status.Text > "" Then
        Call dialtone_off
        Status.Text = ""
   End If
End Sub
-------------------------------------------------------------------------------

Private Sub Form_Unload(Cancel As Integer)

'shut down and release audio hardware
   If Form1.MSComm1.PortOpen = True Then Form1.MSComm1.PortOpen = False
   Call dialtone_off
   ' Make sure recognition is ended!
   ttEndRecognition
End Sub

-------------------------------------------------------------------------------
Private Sub dialtone_on()
'plays the dialtone wav
   On Error Resume Next
   dialtoneplaying = True
   'Declare sound playing api variables
      SND_ASYNC = &H1
      'Play the sound asynchronously -- return immediately after beginning to play the sound and have it play
in the background.
      SND_FILENAME = &H20000
      'lpszName is a string identifying the filename of the .wav file to play.
      SND_LOOP = &H8
      'Continue looping the sound until this function is called again ordering the looped playback to stop.
SND_ASYNC must also be specified.
      SND_PURGE = &H40
      'Stop playback of any waveform sound. lpszName must be an empty string.Dim SYNC As Long
   Dim wav As String
   wav = "c:\windows\dialtone.wav"
   If wav = "" Then Exit Sub
   SYNC = SND_ASYNC Or SND_LOOP
   Dim R As Long
   R = PlaySound(wav, 0, SND_FILENAME Or SND_ASYNC Or SND_LOOP)

   If R = 0 Then MsgBox ("Error! I couldn't get control of the speaker to play dialtone, but the call may still
work.  You may have to stop other audio programs or check device settings in Control panel, Multimedia,
Playback (Use preferred device only)")

End Sub
Private Sub dialtone_off()
   On Error Resume Next
   dialtoneplaying = False
   'Declare sound playing api variables
      SND_ASYNC = &H1
      'Play the sound asynchronously -- return immediately after beginning to play the sound and have it play
in the background.
      SND_FILENAME = &H20000
```

```
    'lpszName is a string identifying the filename of the .wav file to play.
    SND_LOOP = &H8
    'Continue looping the sound until this function is called again ordering the looped playback to stop.
SND_ASYNC must also be specified.
    SND_PURGE = &H40
    'Stop playback of any waveform sound. lpszName must be an empty string.Dim SYNC As Long
    SND_NODEFAULT = &H2

  wav = "c:\windows\off.wav"
  R = PlaySound("", 0, SND_PURGE Or SND_NODEFAULT)
End Sub
-------------------------------------------------------------------------------

Private Sub Timer3_Timer()
' this timer is for Phonefree
' don't waste time if phone is on hook

If dialing = True And Form1.MSComm1.DSRHolding = False Then
'check to see if I should start dialtone

If dialtoneplaying = False And Status.Text = "" Then Call dialtone_on
  'wait for right number of digits, and kill dialtone on the first one

If Len(Status.Text) > 0 Then
   Call dialtone_off

    If Len(Status.Text) > 10 Then
       '  recognition is ended
       ttEndRecognition
       'run the application
       AppActivate ("PhoneFree")
       SendKeys Status.Text & "~"
       dialing = False
       talking = True
       Status.Text = ""
    End If

  End If  ' if flag = true
End If
If talking = True And Form1.MSComm1.DSRHolding = True Then
  talking = False

 ' Uncomment this when Phonefree gets their hotkeys working again
  'In the meantime, just hope the other party hangs up within 15 seconds

  'AppActivate ("PhoneFree")
  'SendKeys "+H", 1
  Delay (3000)
  'SendKeys "%N", 1
  'EnableDialer_Click
  Call Reset_Click
End If
If dialing = True And MSComm1.DSRHolding = True And Status.Text > "" Then
    Call dialtone_off
    Status.Text = ""
End If
End Sub
```

Figure 7 DTMF detection software parameter tuning

| score | Noise Gate | Noise/Signal | Tone Duration | Silence Duration | Pri/Harmonic Ratio |
|---|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 450495 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 25 |
| 0 | 450495 | 25 | 1 | 1 | 0 |
| 0 | 450495 | 50 | 1 | 1 | 0 |
| 0 | 1000000 | 25 | 1 | 1 | 0 |
| 0 | 1000000 | 50 | 1 | 1 | 0 |
| 0 | 0 | 1 | 10 | 1 | 12 |
| 0 | 0 | 1 | 10 | 1 | 25 |
| 0 | 495050 | 12 | 5 | 1 | 0 |
| 0 | 495050 | 12 | 10 | 1 | 0 |
| 0 | 495050 | 12 | 1 | 5 | 0 |
| 0 | 495050 | 12 | 1 | 10 | 0 |
| 0 | 495050 | 12 | 1 | 1 | 12 |
| 0 | 495050 | 12 | 1 | 1 | 25 |
| 1 | 1000000 | 1 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 12 |
| 1 | 450495 | 1 | 1 | 1 | 25 |
| 1 | 0 | 1 | 5 | 1 | 25 |
| 1 | 0 | 1 | 1 | 5 | 25 |
| 1 | 0 | 1 | 10 | 10 | 0 |
| 1 | 0 | 1 | 1 | 10 | 12 |
| 1 | 0 | 1 | 1 | 10 | 25 |
| 2 | 0 | 1 | 1 | 5 | 0 |
| 2 | 0 | 25 | 10 | 1 | 0 |
| 2 | 1000000 | 1 | 10 | 1 | 0 |
| 2 | 0 | 1 | 10 | 5 | 0 |
| 3 | 0 | 25 | 1 | 1 | 0 |
| 4 | 450495 | 1 | 10 | 1 | 0 |
| 4 | 0 | 25 | 1 | 10 | 0 |
| 4 | 0 | 1 | 5 | 1 | 12 |
| 5 | 0 | 1 | 1 | 10 | 0 |
| 5 | 450495 | 1 | 1 | 1 | 12 |
| 5 | 0 | 50 | 1 | 10 | 0 |
| 6 | 0 | 25 | 1 | 5 | 0 |
| 6 | 0 | 25 | 1 | 1 | 25 |
| 6 | 0 | 1 | 1 | 5 | 12 |
| 6 | 0 | 50 | 10 | 1 | 0 |
| 7 | 1000000 | 1 | 1 | 1 | 12 |
| 7 | 0 | 50 | 1 | 1 | 12 |
| 7 | 0 | 50 | 1 | 1 | 25 |
| 8 | 0 | 50 | 1 | 1 | 0 |
| 8 | 0 | 1 | 5 | 1 | 0 |
| 8 | 0 | 25 | 1 | 1 | 12 |
| 8 | 0 | 1 | 5 | 10 | 0 |
| 8 | 0 | 50 | 5 | 1 | 0 |
| 9 | 0 | 1 | 10 | 1 | 0 |
| 9 | 0 | 1 | 5 | 5 | 0 |
| 9 | 1000000 | 1 | 5 | 1 | 0 |
| 9 | 1000000 | 1 | 1 | 5 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| 9 | 1000000 | 1 | 1 | 10 | 0 |
| 9 | 1000000 | 1 | 1 | 1 | 25 |
| 9 | 0 | 50 | 1 | 5 | 0 |
| 10 | 450495 | 1 | 5 | 1 | 0 |
| 10 | 450495 | 1 | 1 | 5 | 0 |
| 10 | 450495 | 1 | 1 | 10 | 0 |
| 10 | 0 | 25 | 5 | 1 | 0 |

Figure 8 DTMF Detection Library function

```
// ---------------------------------------------------------------------
// Main.c - Murphy McCauley
Sun, Oct 1 / 2000
// The interface and heart of ttLib
// ---------------------------------------------------------------------


// ---------------------------------------------------------------------
// Misc
// ---------------------------------------------------------------------

// This is the main file
#define MAIN

// ---------------------------------------------------------------------



// ---------------------------------------------------------------------
// Includes
// ---------------------------------------------------------------------

#include "ttLib.h"
#include "Main.h"
#include "DFT.h"
#include "Util.h"

#include <math.h>                    // For floor() (I think that's all...)
#include <process.h>       // For threading
#include <mmsystem.h>   // For audio

// ---------------------------------------------------------------------



// ---------------------------------------------------------------------
// Callback settings (File scope variables)
// ---------------------------------------------------------------------

// This is a function pointer to the function to call when a key has been
// recognized.  This function implements a callback behavior.
GotKeyType                  pGotKeyFunc;

// If the callback method is one that calls a function, this is a pointer to
// the function to call.
CallbackType      pCallbackFunc;

// If the callback method is one that notifies via a window, this is the
// window that recieves the notification.
HWND                        pCallbackWindow;

// If the callback method is one that notifies via a window, this is the
// window message to send.
int                                 pCallbackMessage;
```

```
// ------------------------------------------------------------

// ------------------------------------------------------------
// Misc variables (File scope variables)
// ------------------------------------------------------------

// WAVEHDRs for the chunks
WAVEHDR       pWaves[NUM_CHUNKS];

// Pointer to the entire audio data buffer (for all chunks)
short * pWaveData;

// Pointers within pWaveData -- one for each chunk
short * pChunkData[NUM_CHUNKS];

// Handle of the audio input device
HWAVEIN phDev;

// The waveform format
WAVEFORMATEX pFormat;

// When TRUE, the decoding loop will exit
volatile BOOL pQuitNow = FALSE;

// Handle of the recognizer thread
HANDLE phThread;

// Audio device to open
UINT pAudioDevice = WAVE_MAPPER;

// Translates a row and column into a key
static char pKeys[4][4] = {{'1', '2', '3', 'O'}, // O - Flash Override (FO/A)
                           {'4', '5', '6', 'F'}, // F - Flash (F/B)
                           {'7', '8', '9', 'I'}, // I - Immediate (I/C)
                           {'*', '0', '#', 'P'}};// P - Priority (P/D)

// ------------------------------------------------------------


// ------------------------------------------------------------
// Recognizer settings (File scope variables)
// ------------------------------------------------------------

// This is a noise gate to stop excessively noisy signal from being
// considered as a tone candidate.
int pMinNoise = DEFAULT_MIN_NOISE;

// This is the number of sampling intervals that must pass until
// a key is considered pressed (currently a 12.75ms sampling interval
// is hard coded).  I suggest 3 -- 3 * 12.75 = 38.25
int pToneDur = DEFAULT_TONE_DURATION;

// This is the number of sampling intervals that must pass between
// keys (currently a 12.75ms sampling interval is hard coded).
// I suggest 3 -- 3 * 12.75 = 38.25
int pSilenceDur = DEFAULT_SILENCE_DURATION;
```

```
// This determines how much stronger the detected tones must be
// compared with the rest of the signal.  Likely range is 10 - 50.
int pSignalToNoise = DEFAULT_SIGNAL_TO_NOISE;

// These are the ratio between the primary tone and its harmonic.
// The higher they are, the stronger the primary tone must be in
// comparison, which will make the thing less likely to misfire.
// Likely range is 0 - 25.  In my testing, most sources are noisy
// enough to throw this off rather easily for at least on frequency.
// I suspect this is due to the tone generators.
int pRowRatio = DEFAULT_ROW_RATIO;
int pColRatio = DEFAULT_COL_RATIO;

// ---------------------------------------------------------------------------



// ---------------------------------------------------------------------------
// Misc. internal functions
// ---------------------------------------------------------------------------

int CalcNumSamples(double MS, int Rate) {
        double T;
        T = MS * (Rate / 1000.0);
        if (floor(T) < T) {
                return (int)(floor(T) + 1);
        } else {
                return (int)floor(T);
        }
}


unsigned __stdcall ThreadProc (LPVOID Dummy) {
        BOOL TempB;

        TempB = Recognize();

        if ( (TempB == FALSE) && (gLastError == tteNoError) ) {
                SetError(tteUnknown);
        }

        _endthreadex(TempB);
        return TempB; // Just for style

// ---------------------------------------------------------------------------



// ---------------------------------------------------------------------------
// Callback handling functions
// ---------------------------------------------------------------------------

// These functions (xCB()) implement callback methods
void SendMessageCB (char Key) {
        SendMessage(pCallbackWindow, pCallbackMessage, Key, Key);
}
void PostMessageCB (char Key) {
        PostMessage(pCallbackWindow, pCallbackMessage, Key, Key);
}
```

```
void DirectFunctionCB (char Key) {
        pCallbackFunc(Key);
}


// Used to set set up a callback method -- a fairly silly (but
// straightforward) implementation.
BOOL SetCallback(ttCallbackMethods Method, int CB) {
        switch (Method) {
                case ttcmPostMessage:
                        pCallbackWindow = (HWND)CB;
                        pGotKeyFunc = PostMessageCB;
                        if (!pCallbackWindow) {
                                SetError(tteBadParameter);
                                return FALSE;
                        }
                        break;
                case ttcmSendMessage:
                        pCallbackWindow = (HWND)CB;
                        pGotKeyFunc = SendMessageCB;
                        if (!pCallbackWindow) {
                                SetError(tteBadParameter);
                                return FALSE;
                        }
                        break;
                case ttcmDirectFunction:
                        pCallbackFunc = (CallbackType)CB;
                        pGotKeyFunc = DirectFunctionCB;
                        if (!pCallbackFunc) {
                                SetError(tteBadParameter);
                                return FALSE;
                        }
                        break;
                default:
                        SetError(tteNotSupported);
                        return FALSE;
        }

        return TRUE;
}

// ------------------------------------------------------------------


// ------------------------------------------------------------------
// Interface functions (prototyped in ttInterface.h)
// ------------------------------------------------------------------

TouchToneErrors EXPORT ttGetErrorVal() {
        TouchToneErrors ret;
        ret = gLastError;
        gLastError = 0;
        return ret;
}


BOOL EXPORT ttInitializeEx (ttInitializeExInfo * Info) {
        SetError(tteNoError);
```

```
        if (Info->StructSize != sizeof(ttInitializeExInfo)) {
                SetError(tteNotSupported);
                return FALSE;
        }
        if (!SetCallback(Info->CallbackMethod, Info->CallbackInfo1)) {
                return FALSE;
        }

        pCallbackMessage= autosetp(&Info->CallbackInfo2, DEFAULT_CALLBACK_MESSAGE);

        pMinNoise               = autosetp(&Info->MinNoise,             DEFAULT_MIN_NOISE);
        pToneDur                = autosetp(&Info->ToneDuration,  DEFAULT_TONE_DURATION);
        pSilenceDur     = autosetp(&Info->SilenceDuration,DEFAULT_SILENCE_DURATION);
        pSignalToNoise  = autosetp(&Info->SignalToNoise, DEFAULT_SIGNAL_TO_NOISE);
        pRowRatio               = autosetp(&Info->RowRatio,             DEFAULT_ROW_RATIO);
        pColRatio               = autosetp(&Info->ColRatio,             DEFAULT_COL_RATIO);

        pAudioDevice    = (UINT)autosetp(&Info->DeviceOverride, DEFAULT_DEVICE);

        return TRUE;
}


BOOL EXPORT ttInitialize (ttCallbackMethods Method, int CB) {
        SetError(tteNoError);

        if (!SetCallback(Method, CB)) {
                return FALSE;
        }

        pCallbackMessage = DEFAULT_CALLBACK_MESSAGE;
        pMinNoise               = DEFAULT_MIN_NOISE;
        pToneDur                = DEFAULT_TONE_DURATION;
        pSilenceDur     = DEFAULT_SILENCE_DURATION;
        pSignalToNoise  = DEFAULT_SIGNAL_TO_NOISE;
        pRowRatio               = DEFAULT_ROW_RATIO;
        pColRatio               = DEFAULT_COL_RATIO;

        pAudioDevice    = DEFAULT_DEVICE;

        return TRUE;
}


BOOL EXPORT ttBeginRecognition () {
        int ThreadID;

        if (phThread) {
                SetError(tteWrongState);
                return FALSE;
        }

  pFormat.wFormatTag = WAVE_FORMAT_PCM;
  pFormat.nChannels = 1;
  pFormat.nSamplesPerSec = 11025; // 11kHz
  pFormat.wBitsPerSample = 16;
  pFormat.nBlockAlign = (pFormat.nChannels * pFormat.wBitsPerSample) / 8;
  pFormat.nAvgBytesPerSec = pFormat.nBlockAlign * pFormat.nSamplesPerSec;
```

```
    pFormat.cbSize = 0;

        if (!phDev) {
                waveInOpen(&phDev, pAudioDevice, &pFormat, 0, 0, CALLBACK_NULL);
        }
    if (!phDev) {
                SetError(tteWaveDeviceDidNotOpen);
                return FALSE;
        }

        waveInStart(phDev);

        phThread = (HANDLE)_beginthreadex(
          NULL,
          0,
          ThreadProc,
          NULL,
          0,
          &ThreadID);

        if (phThread) {
                return TRUE;
        } else {
                waveInReset(phDev);
                waveInClose(phDev);
                phDev = 0;
                return FALSE;
        }
}


BOOL EXPORT ttEndRecognition () {
        if (!phThread) {
                // It's not running!
                SetError(tteWrongState);
                return FALSE;
        }

        // Tell the thread to quit
        pQuitNow = TRUE;

        // Wait for the thread to finish, then clean it up
        WaitForSingleObject(phThread, INFINITE);
        CloseHandle(phThread);
        phThread = NULL;

        // Reset this...
        pQuitNow = FALSE;

        // Close and clean up the wave device
    if (phDev) {
        waveInClose(phDev);
                phDev = NULL;
        }

        return TRUE;
}

// ---------------------------------------------------------------
```